

LIFE-HISTORIES OF SYRPHIDAE II.

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Paragus bicolor (Fabricius).*Larva.*

Length about 8 mm., height about 2.5 mm., width 3.25 mm. (Fig. 21). In superficial appearance somewhat suggesting larva of *Didea fasciata fuscipes*.*

Elongate-oval in outline, somewhat flattened-dorso-ventrally, attenuated gradually to the obtusely pointed anterior end slightly to the truncate posterior end. The color of the integument is light yellowish brown, but it is semi-transparent and various tints of visceral organs show through, making a light line along each lateral carina limited medially by darker. The mid-dorsal region surrounding the black pulsating blood-vessel is a light brick-red color about one-third the width of the larva, due to underlying fatty bodies. On each side of this for a third the remaining width jet-black visceral matter shows through frequently in pulsating pockets. This is limited laterally by a little wider band of yellowish white as contrasted with the narrow remaining margin and the conical elevations which appear drab. However, the color varies considerably with different larvae and at different times in the same larva.

The integument is tough but pliable thrown into numerous transverse folds; papillose but bare.

There are apparently twelve body-segments the anterior three strongly retractile so that when the larva is at rest segment four usually forms the anterior outline of the body. Each of these segments except the first few and the last is marked by about four lateral wrinkles or folds and bears, as in *Didea*, twelve conical elevations each with a spine or bristle at the summit. (Fig. 22). For convenience of reference we may name these segmental spines and the elevations on which they are borne according to their position. Beginning at the mid-dorsal line on either side they are in order: median, dorsal, dorso-lateral, lateral and two ventro-laterals, a posterior ventro-lateral and an anterior ventro-lateral, as one is in front of the other. This will be made clear by referring to Figures 27 and 28 where these spines are indicated on the puparium. The fourth and fifth body-segments in *Paragus bicolor* have the median, dorsal, dorso-lateral and lateral elevations of about equal size (see Fig. 21). The third and the sixth to the eleventh segments, inclusive, have the dorsal ones very much shorter, about one-sixth as large, almost obscure, and situated on the succeeding fold of the integument. The dorso-

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lateral elevations are continuous at their base with two of the transverse folds in each segment and these are so produced as to make a distinct, zig-zag, longitudinal carina along each side of the body. The lateral elevations make a similar underlying carina less pronounced. The ventro-laterals are small, situated on projecting folds antero-ventral to the laterals. Ventrally in segments five to eleven, there are seven pairs of small rounded bare elevations of the integument which serve as pro-legs.

The other appendages consist of mouth-parts, antennae and anterior and posterior spiracles. The mouth-parts are terminal; they consist (Fig. 32) of two beak-like jaws (Fig. 23, *d* and *f*), working vertically, and four pairs of mouth-hooks (Fig. 23, *a* and *e*). The upper jaw is a V-shaped chitinous piece with slender arms, sharply pointed at the apex; the lower one slenderer, more hooked, of solid chitin nearly to the base where there is a spur-like projection ventrally on either side. Three pairs of the mouth-hooks are at the sides of the jaws; slender, the bases embedded in the flesh for half their length, the outer one broader distally and with a lateral spur ventrally; the fourth pair consists of two triangular hooks well separated from the other parts along the side of the first segment. The mouth parts are all black, firmly chitinized and the jaws are continuous internally with broad chitinous plates surrounding the oesophagus (Fig. 23, *b*). Just dorsal to the mouth-parts is the pair of short antennae each with a basal sub-conical fleshy piece and two rounded terminal segments. (Figs. 21, *a*, and 23, *c*). On the anterior part of the third body-segment is a pair of very small spiracles (Fig. 21, *b*). These are difficult to see clearly but apparently consist of a crescent-shaped slit guarded by seven rounded teeth-like lobes (Fig. 24). The posterior respiratory organ (Fig. 21, *c*) consists as in other species of two short cylindrical appendages fused along the middle line and each bearing on the end three slit-like spiracles radiating from a dorsal circular plate. The appendage in *Paragus bicolor* (Figs. 25, 26), is slightly longer than broad, the length being from 0.25 mm. to 0.4 mm., the width 0.25 to 0.3 mm. About mid-length is a slight constriction beyond which the appendage is strongly chitinized and the surface smooth, testaceous brown; proximal to the constriction the surface of the tube is roughly papillose and nearly black. The spiracles are well elevated above the surface of the appendage and are noticeably curved in their extent. (Figs. 25 and 26, *b*).

The inter-spiracular spines* are inconspicuous but the one median to the rather inconspicuous circular plate (Fig. 26, *c*), is large, spoon-shaped, broad dorso-ventrally, narrower from side to side and concave laterally (Figs. 25 and 26, *a*).

* Inter-spiracular spine, a projection of the chitinous surface between any two of the spiracles on the posterior respiratory organ.

The anus is ventral on the last segment.

These larvae were first taken at Columbus, Ohio, on May 31, 1911, when a dozen or more of various sizes were collected on Curled Dock (*Rumex crispus* L.) very badly infested with an aphid (*Myzus* sp.).

On June 4, eggs and larvae were taken from the same host, the eggs hatching the following day. The young thus made their first appearance at this station the latter half of May and the first of June. At Lakeville, Ohio, seventy miles north-east, larvae of differing sizes were collected from both Curled Dock and Broad Leaf Dock (*Rumex obtusifolius* L.) June 15-18. At Sandusky, on Lake Erie, larvae of this species nearly full grown were collected from Curled Dock on June 21 and July 1. At Castalia, June 29, larvae were abundant on Common Burdock (*Arctium minus* Schk.) On July 8 both pupae and larvae were taken in considerable numbers from Burdock at Kelley's Island. Again on August 27th larvae were found on thistle (*Carduus* sp.) at Lakeville, Ohio, among aphids (*Aphis* sp.).

From all the observations made on this species two distinct generations seem evident: one appearing in spring at dates varying from the middle of May to the middle of June or a little later in different parts of the State, a second appearing in August and perhaps later.

On *Rumex* these larvae are to be found among the aphids (*Myzus* sp.) which cluster especially on the heads or flower spikes and the smaller leaves; on thistle on the upper tender parts of stems; on *Arctium* they are more especially on the under side of the large lower spreading leaves. They are parasitic on the aphid colonies catching the individuals with their mouth-parts and killing them by slowly picking out and sucking out all the soft body-contents within the chitinous wall. During this process the mouth parts are manipulated by strong muscles which also move the large chitinous plates about the oesophagus out and in like a battering ram. The anterior two or three segments are pushed inside the sac-like body-wall, and the contents very carefully and completely picked out all around and into the bases of the appendages. Empty skins are dropped and may sometimes be noted.

The larvae are sluggish when plenty of food is at hand, usually nicely protected by position among the aphids and somewhat by colors similar to those of the host plant. They can, however, move actively by looping movements with the assistance of the pro-legs. When in search of food the larva advances a short distance, raises the anterior half of the body and lashes it rapidly from side to side, then advances again and repeats the side lashing until it touches the desired food.

The only particular enemy noted is a small Ichneumonid parasite (*Bassus* sp.) which oviposits through the skin of the larva. The parasitic larva does not prevent the formation of a more or less complete puparium, but emerges as adult about four weeks after pupation of host by gnawing a small irregular hole in the anterior end of the puparium (see Fig. 36). The first indication of the presence of the parasite is usually a failure of the pupal envelope to inflate completely, remaining less rounded up dorsally and often with the anterior segments but little retracted ventrally. Very soon the pupa becomes darker in color than normal, in this species becoming purplish instead of testaceous brown. These characters should be easily told and one with a very little experience might do great good by destroying all such parasitized pupae before the hymenopteron has time to emerge.

Pupa.

Dimensions, average of ten: Length 5.3 mm., height 2.2 mm., width 2.4 mm. Pupation takes place within the indurated larval skin which becomes inflated dorsally and anteriorly, retracted ventrally so that the mouth comes to lie well back on the ventral side. As seen from above (Fig. 27) the puparium is near oval in outline but with sides somewhat straightened and with the breathing appendages giving a more extended outline posteriorly. From in front the puparium is almost circular in outline. As seen from the side (Fig. 28), the ventrum is nearly straight, dipping down slightly anteriorly and posteriorly, thence rounding up strongly to the dorsum. In many specimens the anterior end of the larva has been more strongly retracted ventrally and the anterior and posterior ends more equally rounded up than is shown in Fig. 28.

The color varies from brown-pink to darker sometimes with obliquely transverse banding of testaceous brown and blackish.

The long segmental spines contrasted with the short-dorsals, or their apparent absence on the principal segments, and the short posterior respiratory appendage with its prominent spoon-shaped spurs at the end, dorsally, should serve easily to identify the species.

Date of pupation: Columbus, June 6th and later; Lakeville, June 23 to 26; Sandusky, July 3 and later; Kelley's Island, Lake Erie, July 8 to 13. The duration in the pupa stage was from 5 to 15 days with the majority about 12 days.

The pupae are to be found lodged and fastened among the flowers in the spike and the axils of the leaves, or on the upper side of the leaves of the host plant. They are stuck to the leaves by their posterior end. Protective coloration may be of some importance to the pupae as well as to the larvae.

The adult emerges by pushing off a circular operculum from the anterior end of the pupa-case.

Adult.

Genus *Paragus* Latreille.

Description slightly modified from Williston. Bull. U. S. Nat. Mus., No. 31, 89, (1886), p. 17. Small nearly bare species, abdomen curved downward at the tip black or greenish black with yellow on the face and reddish on the abdomen. Head broader than thorax; antennae about as long as the head, first and second joints short third longer than first two together; arista before the middle bare. Face convex with an obtuse tubercle. Eyes pilose, narrowly contiguous and often with an area of enlarged facets on the upper anterior part in the male. Abdomen as wide as thorax and twice as long of nearly equal width throughout, a shallow transverse depression on each segment, the distal end bent downward. Hind metatarsi much thickened as long as the remaining joints together. Marginal cell of wing open, third longitudinal vein straight, anterior cross-vein near the base of discal cell, the last section of fourth vein sinuate, terminating in a right angle on the third vein at a considerable distance before the tip.

***Paragus bicolor* (Fabricius).**

♂ ♀ Length 5-6 mm. Eyes pubescent, *the pile mostly grouped in two vertical stripes separated by a distinct vertical glabrous stripe* (Figs. 29, 30). Face in the female white pilose with a shining black stripe reaching from antennae to the oral margin, narrower below; *in the male wholly pure light sulphury yellow with yellow pile*. Oval margin and cheeks shining black. Antennae black with some whitish pollen, the under side of the third joint reddish. *Front of female narrowed above*, not more than half as wide at the vertex as at the base of the antennae (Fig. 30); shining black narrowly dusted with whitish on the sides below, the latter not quite reaching the light color on the sides of the face; frontal triangle sulphur yellow, the eyes touching midway, and for about one-fifth the distance, between the anterior ocellus and the base of the antennae; "vertical triangle black light pollinose in front. Thorax black, a little shining with yellowish pile, *in front with two whitish pollinose stripes*. Pleurae silvery white pilose. Scutellum with a whitish border not extending to the anterior angles. Abdomen chiefly red, but variable in color; first segment black; second segment, often wholly black sometimes more or less red behind, sometimes only black on the sides. The black usually extends narrowly along the sides of the third segment, sometimes of the fourth and fifth also; rarely, the third segment has a blackish band. Pile on the sides of the segments in front and on the lateral margins, and on the fifth segment, white, elsewhere obscure. Legs variable, frequently the basal portion of the front and middle femora and the hind femora except the tip are black; elsewhere yellowish. Wings, nearly hyaline; stigma, dilutely yellowish."

Paragus tibialis (Fallen).*Larva.*

Length about 7.5 mm., width 2 to 2.5 mm., height 1.5 mm. Similar in superficial appearance to the previously described *Paragus bicolor* but slenderer and smaller. Color markings variable. Usually the heart line is rather prominent as is also a similar looking dark line along each side of the body about under the dorsal segmental spines. The reddish color is of much less extent than in *P. bicolor* and is largely replaced by a sulphur yellow tinge. In some specimens the general color is uniform light yellowish brown. The segmental spines are shorter and situated on smaller conical elevations than those of *P. bicolor* (Fig. 32), but the dorsal one in segments 6 to 11 is less reduced proportionately, being about one-third as long as the median and dorso-lateral ones. (See Fig. 31).

The most convenient means of separation of the two species in the larval stage is in the length of the posterior breathing appendage. This in *P. tibialis* ranges from about 0.4 mm. to 0.65 or 0.7 mm., with an average of about 0.5 mm. as compared with *P. bicolor* where the length is near 0.3 mm. The width at the tip is about 0.25 to 0.3 mm. as in *P. bicolor*. The appendage besides being distinctly longer is somewhat more bifurcate at the tip in *P. tibialis* and the general surface is slightly more depressed between the spiracular elevations. This will be made clearer by reference to Figs. 25, 26, 33 and 34.

Larvae were taken from common Burdock (*Arctium minus* Schk.) at Lakeville, Ohio, June 21st; at Sandusky, Ohio, from July 30 to August 5; and at Kelley's Island, July 8th. They were found on the upper, but chiefly on the lower side of the leaves of Burdock parasitic in colonies of aphids (species undetermined) the body fluids and viscera of which they devour in the usual manner.

They were found parasitized to a slight extent by the hymenopteron *Bassus* sp.

Pupa.

Dimensions, average of five: length 4.3 mm., width 1.8 mm., height 1.75 mm. Nicely rounded out anteriorly and dorsally, flattened to the surface of the leaf ventrally and attenuated strongly to the posterior respiratory appendage both by depression and by compression (Fig. 35). The posterior appendage is very frequently turned to one side or other from the middle line. General color uniform pale brown to darker, the six spiracular elevations black.

Compared with *P. bicolor* the puparium is less rounded up posteriorly, more attenuated (Fig. 35, cf. Fig. 28). The characters of the posterior, breathing appendage and the segmental spines

remain essentially as in the larva viz., the appendage is longer than in *P. bicolor* the tubes slightly divergent at the tip and the spoon-shaped spine at their tips longer; the segmental spines as a whole are shorter, the dorsal ones in segments 6-11 becoming inconspicuous or entirely invisible.

Pupa from the larva taken at Lakeville, Ohio, June 18th, was formed June 23. Pupae were common in the field at Kelley's Island, July 8. They were taken at Sandusky, Ohio, August 2. Duration in the pupal stage was from 5 to 11 days. Pupation is accomplished within the hardened larval skin. The posterior part especially flattens out on the surface of the leaf becoming glued fast to it while the anterior end becomes inflated, the head segments being retracted ventrally.

For the emergence of the pupa the operculum splits off usually between larval segments 5 and 6 dorsally and just back of the mouth-parts ventrally. The adult emerges with wings crumpled and a conspicuous U-shaped loop in the costal margin about the termination of the first longitudinal vein. The wings expand and harden in an hour or so and the fly is ready for flight.

Adults have been taken from the tenth of May to the latter part of August more often in the first half of June and the first half of August. They are flower feeders but found most commonly in deep meadowy wooded spots hovering in the sunlight or may be taken by beating.

Adult.

Paragus tibialis (Fallen).

♂ ♀ Length 3 to 5 mm. Antennae nearly as long as the head, blackish brown varying to yellowish brown on parts. Face light yellow pilose; yellow on the sides with a broad median black band from antennae to oral margin; projecting below and with a distinct tubercle above the oral margin (Fig. 37). Front in female black, with black pile of nearly equal width throughout (Fig. 38). Frontal triangle in male yellow, vertical triangle large, black, yellowish pilose at the apex, elsewhere the pile darker. Eyes pilose, *the pile not massed in two vertical stripes*, dilute. Thorax entirely greenish-black, shining, with yellowish pile. *No yellow on the scutellum.* Legs light yellow, black on the base of the femora; the hind femora all black except at the tip. Wings hyaline slightly tinged with grayish.

Schiner in Fauna Austriaca cites several varieties separated on the color of the abdomen. The ones I have reared from larvae show the following abdominal markings: In the male the first and second segments are black, the following ones reddish brown with some black, whitish yellow pilose. In the female entirely greenish-black like the thorax with more or less whitish pile.

EXPLANATION OF PLATE XIX.

Figures 21-30 *Paragus bicolor* (Fab.)

- Fig. 21. Mature larva x 10; *a*, antenna; *b*, anterior spiracle; *c*, posterior respiratory organ.
- Fig. 22. A segmental spine of the larva x 40.
- Fig. 23. Antero-lateral view of mouth-parts of larva, much enlarged; *a*, outer pair of mouth hooks; *b*, broad chitinous plates surrounding the oesophagus; *c*, antenna; *d*, upper jaw; *e*, three pairs of lateral mouth-hooks; *f*, lower jaw.
- Fig. 24. Right anterior spiracle highly magnified.
- Fig. 25. Dorsal view of posterior respiratory organ x 60; *a*, the dorsal spine; *b*, one of the radiating spiracles.
- Fig. 26. End view of posterior respiratory organ x 70; *a*, its dorsal spine; *b*, a spiracle; *c*, the circular plate.
- Fig. 27. Dorsal view of puparium x 5; *a*, posterior respiratory organ; *b*, median segmental spine of sixth larval segment; *c*, dorsal and *d*, dorso-lateral spines of sixth and seventh larval segments, respectively.
- Fig. 28. Lateral view of puparium x 5; *a*, posterior respiratory organ; *b*, median spine; *d*, dorso-lateral spine; *e*, lateral spine; *f*, posterior ventro-lateral; and *g*, anterior ventro-lateral.
- Fig. 29. Adult male about seven times natural size.
- Fig. 30. Front view of head of female x 12.

Figures 31-38 *Paragus tibialis* Fallen.

- Fig. 31. Posterior part of a young larva from the side greatly enlarged.
- Fig. 32. Segmental spine of a full grown larva x 40.
- Fig. 33. Dorsal view of posterior respiratory organ of larva x 60; *a*, the dorsal spine; *b*, one of the paired radiating spiracles.
- Fig. 34. End view of posterior respiratory organ x 60; *a*, its dorsal spine, *b*, a spiracle; *c*, the circular plate.
- Fig. 35. Lateral view of puparium x 5; *a*, posterior respiratory organ.
- Fig. 36. Puparium which has been parasitized by hymenopteron, *Bassus* sp. showing typical form and the irregular hole through which the parasite has escaped.
- Fig. 37. Outline drawing of adult male from the side x 8.
- Fig. 38. Head of female x 12.

